Chapter 1

Geography

Outside of the Tunnel

Figure 1.1 Aerial view of the Tevatron ring.

An aerial picture of the Tevatron ring shows several buildings around its circumference. There is a pattern as to how the buildings are arranged. The Tevatron ring is divided into 6 equal sectors, labeled A through F. At the beginning of each sector resides the zero building followed by four evenly spaced service buildings. The zero buildings contain the electronics specific to the specialized functions of the zero locations in the tunnel. Service buildings are labeled 1 through 4, i.e. F1, F2, F3, and F4. Each service building contains diagnostic equipment electronics for beam position monitors and beam loss monitors, a quench protection monitor microprocessor and its associated heater firing units, vacuum electronics, etc. You may be thinking, "What is all that stuff just mentioned?" In upcoming chapters you will learn the function of each of the devices mentioned in this chapter. You may not know how they work right now but at least you know their location. Behind each service building, sitting on the berm, is a satellite refrigerator building that is used for maintaining the flow and temperature of the liquid helium. Scattered around the ring other buildings are found at B48, E17, F17, F23, and F27. Buildings B48 and F17 will be described in the miscellaneous section. The remainder are buildings that pertain to the Main Ring remnant and Pbar transfer lines.

Zero Buildings

The zero buildings contain power supplies and electronics specific for the equipment in the long straight sections. Every zero building contains a room with helium compressors that maintain pressure and flow around the ring. A 386 based microprocessor that controls a sector's refrigerators and compressors can also be found at zero buildings.

Starting east of the high rise is the A0 service building which houses a magnet drop, helium compressors, and a staging area to prepare magnets for installation. The magnet mover can often be found next to the MVA (major vehicle access) gate.

The B0 service building is on the opposite side of the berm from CDF, the Collider Detector Facility. It contains the power supplies for the low β magnets, separators, and spark counters. (If you don't understand the terminology yet, don't worry you will as you read on.)

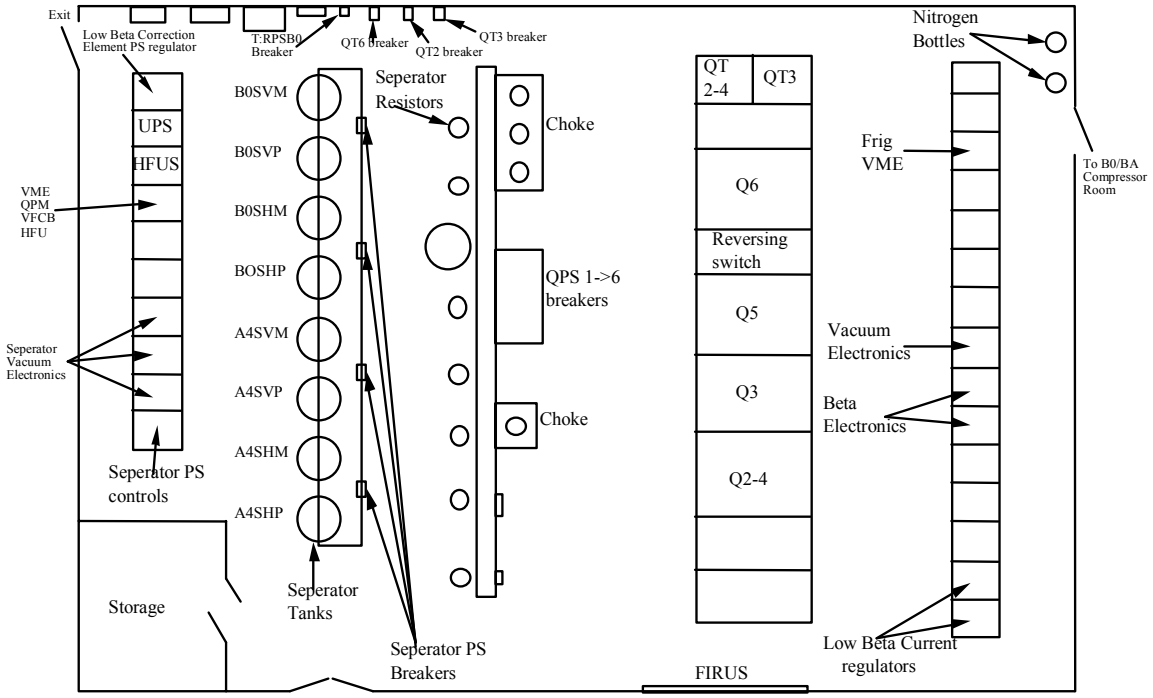


Figure 1.2 B0 service building layout.

Inside the C0 service building you will find the proton abort line electronic diagnostics equipment. The new detector building is located on the opposite side of the berm from the service building.

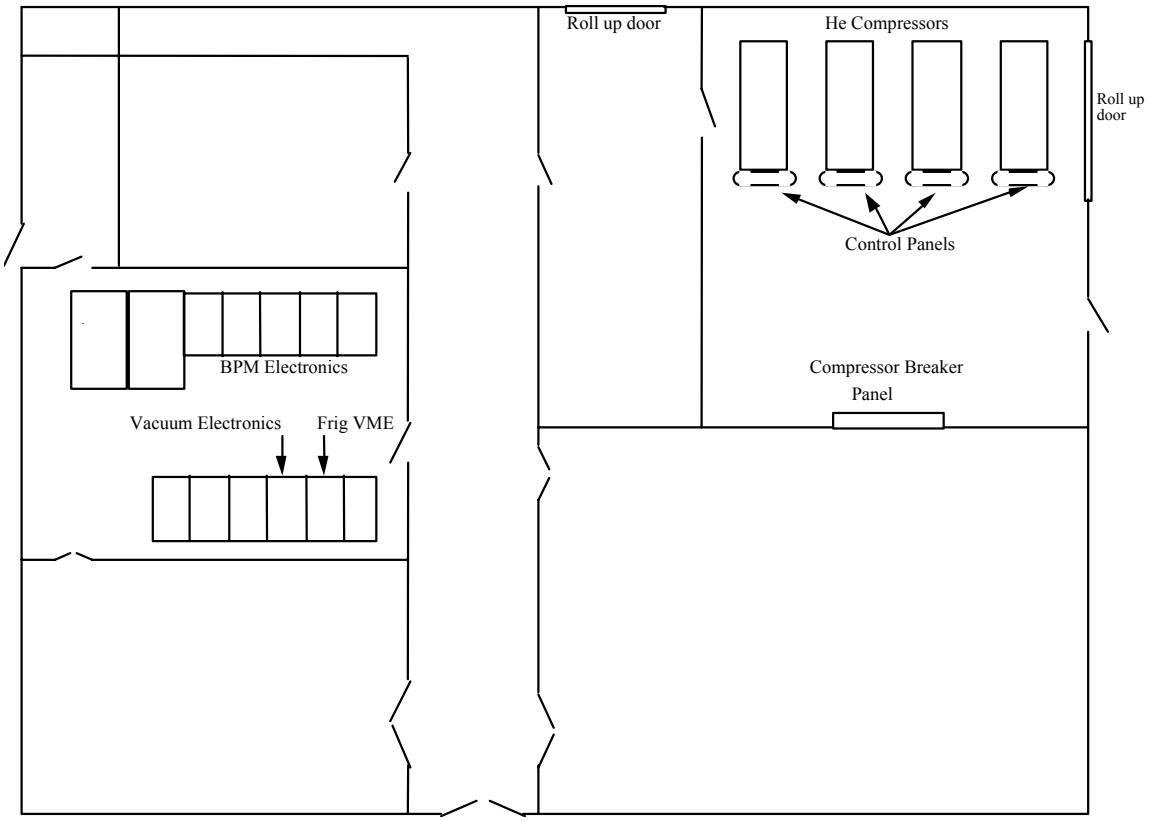


Figure 1.3 C0 service building layout.

The D0 service building is located across the berm from the D0 detector building and next to the magnet storage building. This building is similar to the B0 service building in its contents and layout.

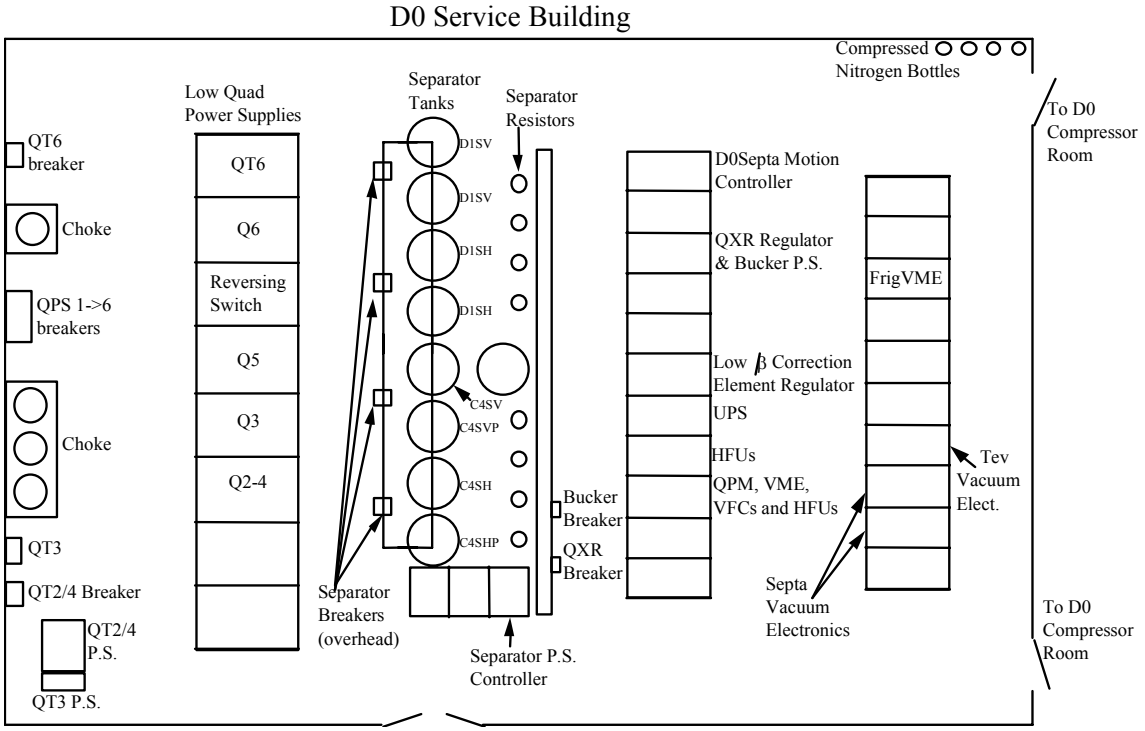


Figure 1.4 D0 service building. In the picture, the left side door is to the electronics room and the middle door is to the compressor room. The diagram above shows the location of various electronics.

The E0 service building contains the electronics that are used for scraping away the protons after a store so that the antiprotons can be recycled. Behind the building is an MVA. In this case MVA means minor vehicle access.

The final zero building is F0, which is also known as the TeV RF building. The building houses all of the equipment used to accelerate the beam from 150 GeV to 1 TeV. Inside you will find the anode power supply, 8 RF modulators, 8 power amplifiers, 8 transmission lines to the cavities, and 8 cavity water stations. All of the Tevatron damper electronics are located in F0. The LLRF VXI crate is located in the MI-60 control room, which is connected to F0 via a hallway. Outside the building, facing north, is the TeV anode power supply manual disconnect.

Service Buildings

Every sector has 4 service buildings labeled 1 through 4. Service buildings are mostly repetitive when it comes to their contents. The buildings contain a heat exchanger for the LCW, an air compressor that holds open vacuum valves and powers the Johnson Controllers, and an electronics room. Inside each electronics room you will find a Quench Protection Monitor with its associated Heater Firing Units and Voltage to Frequency Converters, Beam

Position Monitor and Beam Loss Monitor electronics, a vacuum crate and ion pump power supplies, an Uninterruptible Power Supply system, and dipole correction element power supplies. Higher order correction element power supplies are found in some of the service buildings. Outside of the 1 and 4 service buildings, facing the berm, is a tunnel fan. The fan at an even numbered building forces air into the tunnel and odd pulls air out. Just remember the phrase "odd man out."

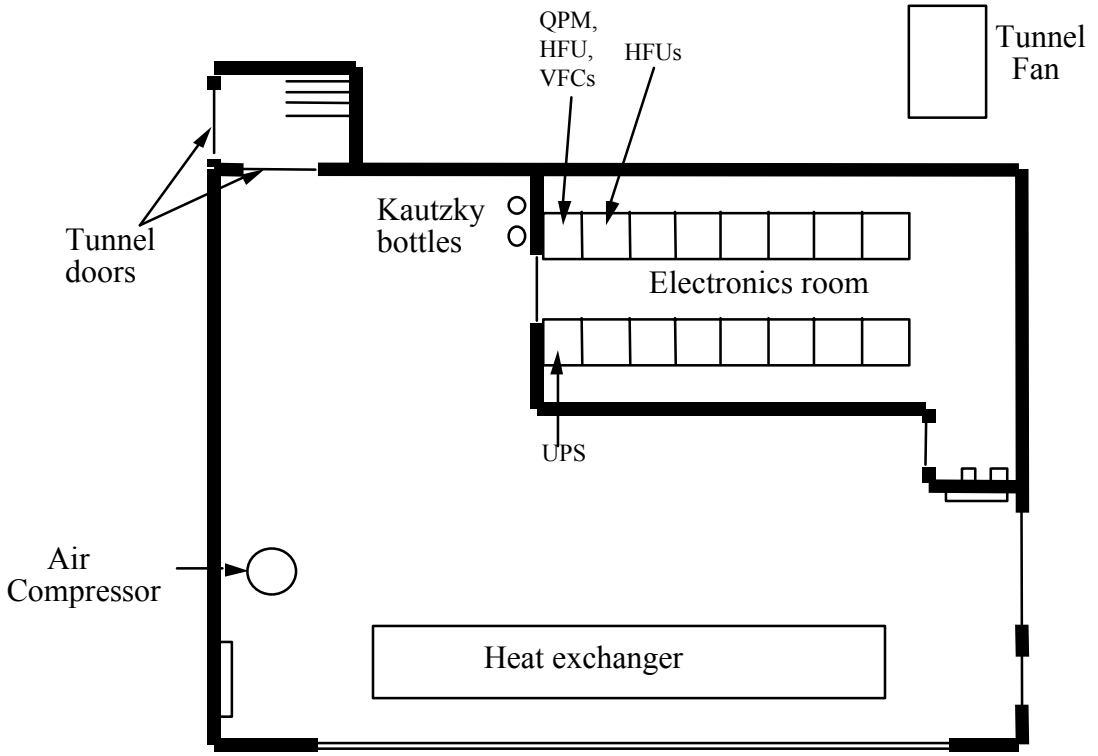


Figure 1.5 Tevatron service buildings 1 and 4.

The 2 and 3 numbered service buildings contain the power supplies that provide current to the TeV bus. Outside of these buildings you will find the manual disconnect, Vacuum Circuit Breaker cabinet, and transformer for the Tevatron power supply. On the opposite side of the building resides the ¼ Ω dump resistor that is used to dissipate the power in the TeV bus. Because of the power supplies at these locations there will be extra equipment inside the building. The actual power supply resides outside of the electronics room and contains the commutating SCR (Silicon Controlled Rectifier) modules for rectifying the three-phase voltage signal from the transformer. Next to the power supply is a choke that is one part of the passive filter system. The remainder of the passive filter system is in the Filter/Dump cabinet. In the cabinet you will find the shunt and series SCR modules, a 1900 μf capacitor bank, the dump switch power module, and the knife switches used for placing the supply in or out of the circuit. Inside the electronics room you will also find equipment related to the power supply such as the CVT (Constant Voltage Transformer), TeV emergency off button, SPU (Standby Power Unit), QBS (Quench Bypass Switch) controller, safety coordinator, AC controller, and SCR firing unit.

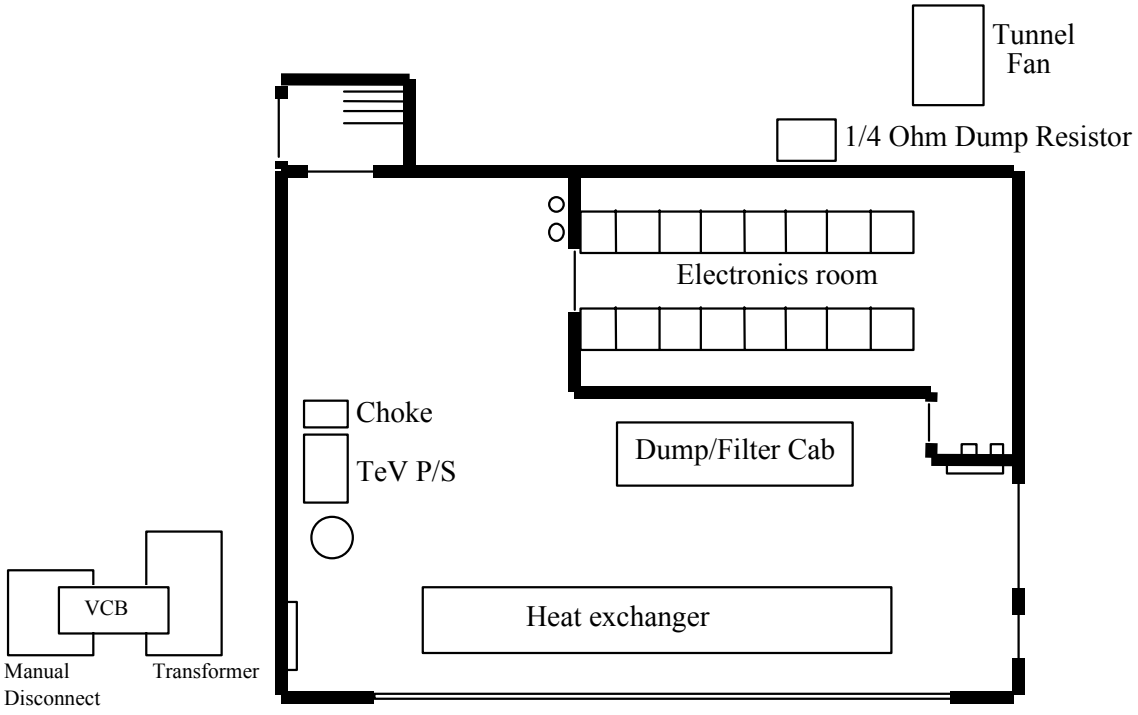


Figure 1.6 Tevatron service buildings 2 and 3.

Refrigerator Buildings

There are 24 refrigerator buildings ring wide, each located on top of the berm, directly behind a service building. A helium transfer line, also on the berm, runs the circumference of the ring connecting each refrigerator building with CHL. Next to the transfer line is the 3" discharge line, which is smaller in radius than the transfer line. Located over the transfer and discharge line is a blue cylindrical object called a heat exchanger.

Inside a refrigerator building you will find a wet and dry expander engine, valve box, bayonet can, suction header, device I/O crate, and cold compressor. Outside, next to the door is the crash button, which valves off the discharge line and thus bypasses high pressure warm helium around the building. On the roof of the building reside the relief valves for the nitrogen and helium suction headers. The reliefs vent those gases during rapid expansion.

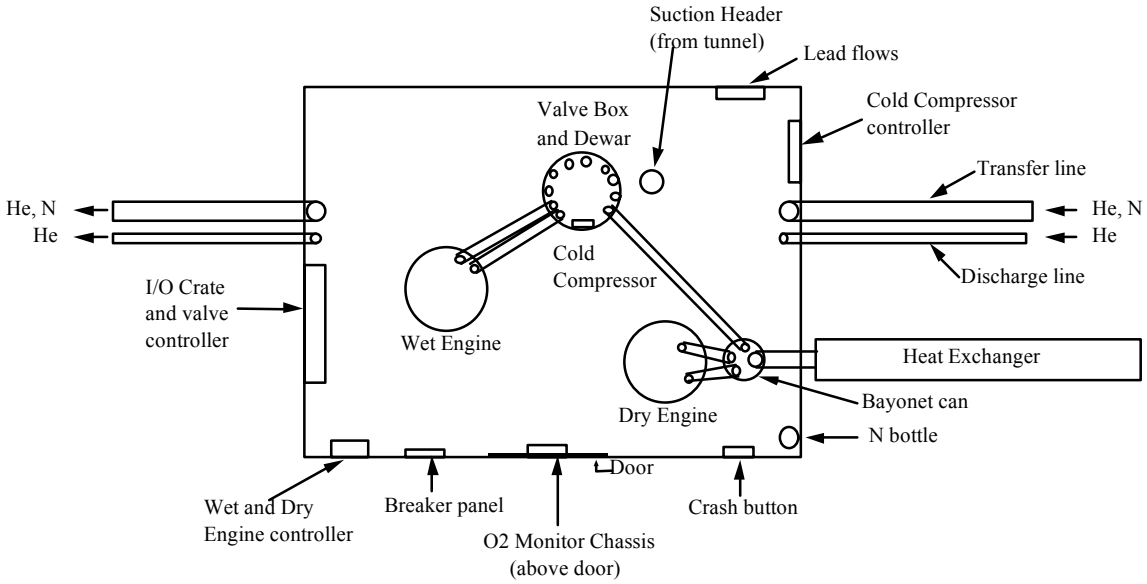


Figure 1.7 Top picture is a typical refrigerator building. Bottom picture is a frig layout.

In the Tunnel

The Tevatron ring is broken up into 6 symmetric sectors which are designated A, B, C, D, E, and F. Each sector starts with a section called the "zero" location and then the rest of the sector is broken up into four repetitive areas called "houses", labeled 1 through 4. At the

zero locations of each sector are long straight sections with specialized functions. A0 contains the proton/antiproton beam abort for collider. B0, C0, and D0 contain the collider detectors for top and bottom quark physics, supersymmetry studies, etc. Also located at C0 is the proton abort line. The E0 straight section contains the scrapers that remove circulating protons but not pbars after a collider store so they can be recycled. F0 contains the 8 accelerating RF cavities as well as the P1 and A1 injection lines from Main Injector.

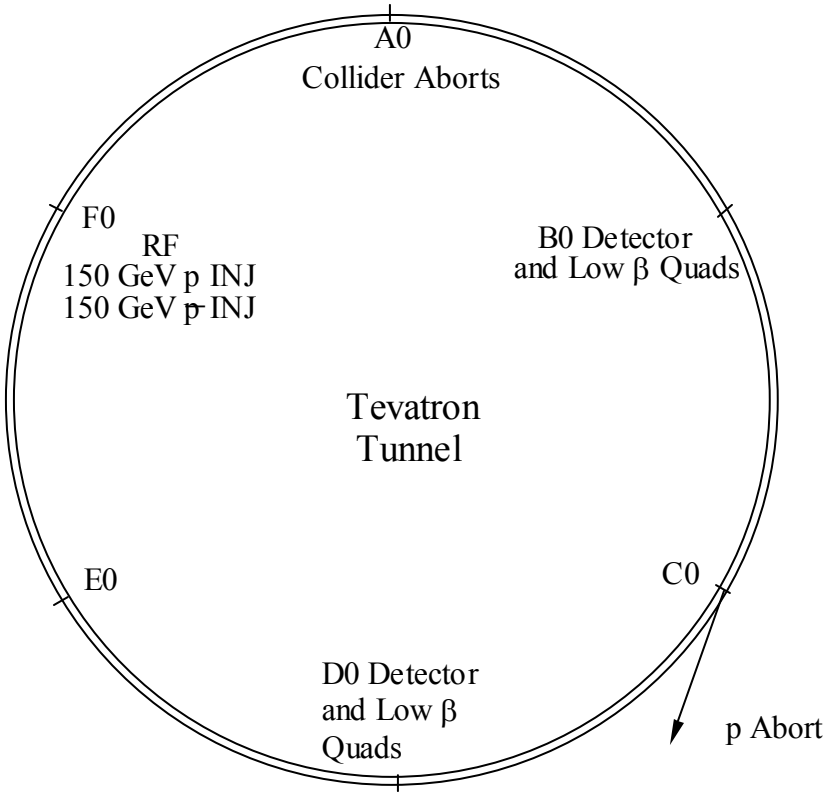
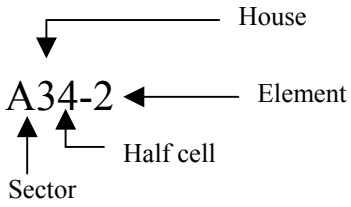


Figure 1.8 Tevatron tunnel.

Houses consist of a number of repeating series of magnets called cells. Each cell has 10 magnets, 2 quadrupoles and 8 dipoles. You will learn more about magnets in chapter 2. Houses 1 and 2 have 4 ½ cells each and houses 3 and 4 both contain 4 cells. This yields 17 cells for one sector. A cell starts with a quadrupole followed by 4 dipoles followed by another quadrupole and 4 more dipoles.



The numbering scheme for magnets in the tunnel is that a quadrupole is the first element of the half cell. If you were given a magnet number of A21-1 then you would know that you are in A sector, house 2, half cell 1, and element number 1. The diagram below should help clarify the numbering scheme. When you enter the tunnel from a service building you will be at the beginning of the 5 location for that house, so at the bottom of the A3 stairwell is the A35-1 magnet, etc.

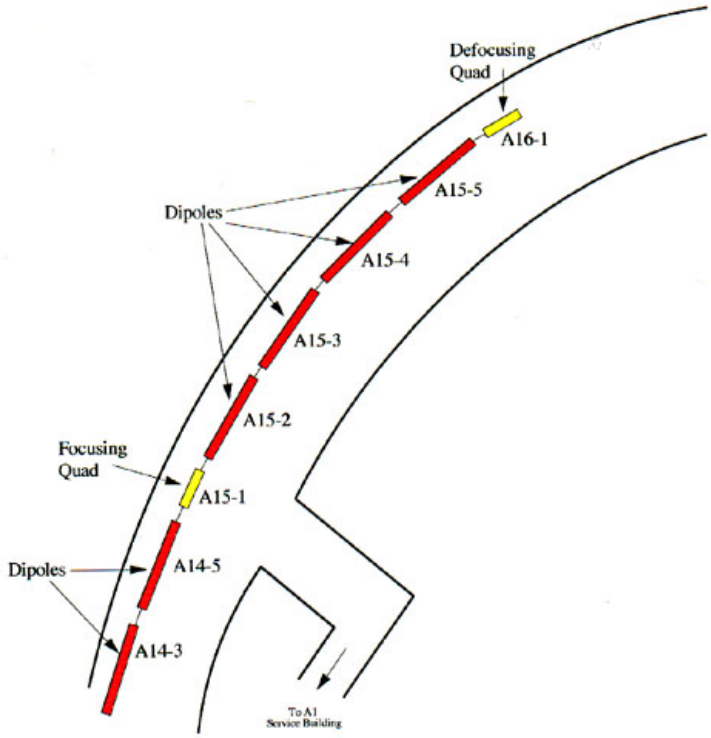


Figure 1.9 Example of the magnet numbering scheme.

To determine whether the quadrupole is focusing or defocusing depends upon what part of the sector you are in. In the 1 house all of the even numbered quads are defocusing and the focusing are odd numbered. The 2, 3, and 4 houses have the numbering scheme reversed. Reference the above diagram. The A15-1 quad is a focusing magnet. The box below shows the TeV ring numbering scheme.

Sector Numbering Scheme							
1 house		2 house		3 house		4 house	
Hor	Vert	Hor	Vert	Hor	Vert	Hor	Vert
11			21	32		42	
	12	22	23	34	33	44	43
13	14	24	25	36	35	46	45
15	16	26	27	38	37	48	47
17	18	28			39		49

Figure 1.10 Magnet numbering scheme for each sector